

# EXERCISE 1

## METRIC CONVERSIONS

**Objective:** To practice making unit conversions between the English system and the metric (S.I.) system of measurement.

**Reference:** McKnight and Hess, *Physical Geography*, 8th ed., pp. 13–14.

### METRIC CONVERSIONS

While the general public in the United States still uses the so-called “English” system of measurement (e.g., feet, miles), most of the rest of the world—and the entire scientific community—use the metric system (e.g., meters, kilometers). Today, the metric system has been incorporated into what is formally known as the *Système International* or *S.I.* system of measurement. In this Lab Manual you will encounter both English units and S.I. units of measure. It is useful for you to be comfortable using both systems, and for you to be able to convert units from one system into the other.

There are two levels of conversion precision that may be useful to you. First, it is helpful to have a rough idea of the equivalents—the kind of conversion you can do quickly in your head without a calculator. For example, it is useful to know that one kilometer is about 2/3 of a mile. The second kind of conversion is a precise equivalent—for example, one kilometer = 0.621 mile. These exact conversions are necessary if a precise measurement in one system must be duplicated in the other system. Some commonly used conversions are given below (to an accuracy of 3 decimal places). Additional conversions factors are found on the back cover of the Lab Manual.

#### Conversions: S.I. to English

	Approximate Conversions	Exact Conversions
<b>Distance:</b>	1 centimeter = a little less than 1/2 inch	cm × 0.394 = inches
	1 meter = a little more than 3 feet	m × 3.281 = feet
	1 kilometer = about 2/3 mile	km × 0.621 = miles
	1 cm (centimeter) = 10 mm (millimeters)	
	1 m (meter) = 100 cm	
	1 km (kilometer) = 1000 m	
<b>Volume:</b>	1 liter = about 1 quart	liters × 1.057 = quarts
<b>Mass (Weight):</b>	1 gram = about 1/30 ounce	g × 0.035 = ounces
	1 kilogram = about 2 pounds	kg × 2.205 = pounds
	1 kg (kilogram) = 1000 g (grams)	
<b>Temperature:</b>	1°C change = 1.8°F change	(°C × 1.8) + 32 = °F

## Conversions: *English to S.I.*

	<u>Approximate Conversions</u>		<u>Exact Conversions</u>	
<b>Distance:</b>	1 inch	= about $2\frac{1}{2}$ cm	inches	$\times$ 2.540 = centimeters
	1 foot	= about $\frac{1}{3}$ m	feet	$\times$ 0.305 = meters
	1 yard	= about 1 m	yards	$\times$ 0.914 = meters
	1 mile	= about $1\frac{1}{2}$ km	miles	$\times$ 1.609 = kilometers
<i>1'(foot) = 12"(inches)</i>				
<i>1 yard = 3'</i>				
<i>1 mile = 5280'</i>				
<b>Volume:</b>	1 quart	= about 1 liter	quarts	$\times$ 0.946 = liters
	1 gallon	= about 4 liters	gallons	$\times$ 3.785 = liters
<i>1 gallon = 4 quarts</i>				
<b>Mass (Weight):</b>	1 ounce	= about 30 g	ounces	$\times$ 28.350 = g
	1 pound	= about $\frac{1}{2}$ kg	pounds	$\times$ 0.454 = kg
<i>1 lb. (pound) = 16 oz (ounces)</i>				
<b>Temperature:</b>	1°F change	= about 0.6°C change	$(^{\circ}\text{F} - 32) \div 1.8 = ^{\circ}\text{C}$	

## Rounding

In scientific work many of the numbers used are measured quantities and so are not exact—they are limited by the precision of the instrument used in the measurement. Further, calculations based on measured quantities can be no more precise than the original measurements themselves. Therefore, measurements and the results of calculations should be recorded in a way that shows the degree of measurement precision. For example, if you use an electronic calculator to divide the following two measured quantities, you would get:

$$5.7 \text{ centimeters} \div 1.75 \text{ minutes} = 3.2571429 \text{ cm/min.}$$

But is 3.2571429 cm/min. a truly correct answer? Not really. In general, the greater the number of digits in a measurement or calculation answer, the greater the implied precision of measurement. A mathematical operation cannot make your measurements more precise. In the example above, our distance measurement is only accurate to tenths of centimeters (perhaps limited by the measuring device we used), and our final answer can be no more precise than this. So:

$$5.7 \text{ centimeters} \div 1.75 \text{ minutes} = 3.3 \text{ cm/min.}$$

When rounding off numbers, if the first digit to be dropped is less than 5, leave the preceding digit unchanged; if the first digit to be dropped is 5 or greater, increase the preceding digit by one. So: 6.74 becomes 6.7, while 6.75 becomes 6.8.

Your instructor may introduce the concept of **significant digits** to you. This will further extend your understanding of the proper rounding of measured quantities.

Name \_\_\_\_\_

Section \_\_\_\_\_

**EXERCISE 1 PROBLEMS—PART I**

1. Complete the following conversions using exact conversion factors (round your answers to one decimal place):

<u>S.I. Units</u>	<u>English System Units</u>
(a) 14 centimeters	_____ inches
(b) 29 meters	_____ feet
(c) 175 kilometers	_____ miles
(d) 42 liters	_____ quarts
(e) 57 grams	_____ ounces
(f) 65 kilograms	_____ pounds
(g) 37°C	_____ °F

2. Complete the following conversions using exact conversion factors (round your answers to one decimal place):

<u>English System Units</u>	<u>S.I. Units</u>
(a) 3 inches	_____ centimeters
(b) 4.3 feet	_____ meters
(c) 18 yards	_____ meters
(d) 73 miles	_____ kilometers
(e) 6.2 quarts	_____ liters
(f) 10 gallons	_____ liters
(g) 14 ounces	_____ grams
(h) 155 pounds	_____ kilograms
(i) 47°F	_____ °C

Name \_\_\_\_\_

Section \_\_\_\_\_

### EXERCISE 1 PROBLEMS—PART II

1. Complete the following conversions using exact conversion factors (round your answers to one decimal place):

<u>S.I. Units</u>	<u>English System Units</u>
(a) 72 centimeters	_____ inches
(b) 24 meters	_____ feet
(c) 1,300 kilometers	_____ miles
(d) 4.5 liters	_____ quarts
(e) 144 grams	_____ ounces
(f) 228 kilograms	_____ pounds
(g) 12°C	_____ °F

2. Complete the following conversions using exact conversion factors (round your answers to one decimal place):

<u>English System Units</u>	<u>S.I. Units</u>
(a) 55 inches	_____ centimeters
(b) 1,774 feet	_____ meters
(c) 220 yards	_____ meters
(d) 23,900 miles	_____ kilometers
(e) 24 quarts	_____ liters
(f) 300 gallons	_____ liters
(g) 26 ounces	_____ grams
(h) 4,500 pounds	_____ kilograms
(i) 88°F	_____ °C